



Annual Reports :: Year 6 :: University of Colorado, Boulder

Project Report: The Historical Character of Astrobiology and Circumventing the Problem of Defining "Life"

Project Investigator:

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Project Progress

I continued investigating the question of how to search for extraterrestrial life in the absence of a definition of 'life'; in previous work, I concluded that it is a mistake for scientists to try to define "life". Because we lack a general theory of living systems it is unlikely that scientists will recognize genuinely strange life for what it is if they come across it. Recognizing strange life presupposes an adequately general theory of life, and formulating the latter requires systematically searching for what Thomas Kuhn called "anomalies." Anomalies are physical systems that resemble terrestrial life in provocative ways and yet are neither clearly living nor clearly non-living. The recognition of strange life thus begins with the verification and exploration of anomalies as grist for the theoretical mill. Verification presupposes the identification and use of trustworthy terrestrial biosignatures to help distinguish genuine anomalies from uninteresting false positives and false negatives arising from unanticipated interfering conditions; this represents an application of my previous work on historical science. The exploration of anomalies requires that anomalies become a focus of research—something sought out and pursued—rather than dismissed on speculative theoretical grounds (that inevitably reflect our pre-existing theoretical conceptions of life). The basic idea is to push beyond the boundaries of life as we know it.

My investigations into this area are currently two pronged. I am pursuing (with biochemist Shelley Copley) the possibility that Earth is home to strange microbial life that has hitherto not been recognized because our techniques for identifying microbial life are based too closely on the biochemistry and molecular biology of familiar terrestrial life. I am also beginning work on the question of how to search for and recognize potentially fruitful anomalies to our current concept of life. This is related but not identical to the question of designing suites of biosignatures for detecting extraterrestrial life; it differs from it insofar as the search is not for biology per se but for physical systems that are provocatively similar to and yet also different from familiar life.

Highlights

- When it comes to genuinely strange extraterrestrial life, it is not at all clear that we will recognize it if we see it. Our capacities to recognize life are constrained by our current beliefs about life, and these in turn are based upon our limited experience with familiar terrestrial life.
- The search for genuinely strange extraterrestrial life begins with the verification and exploration of anomalies, physical systems that resemble terrestrial life in provocative ways and yet are neither clearly living nor clearly non-living. It is only through the discovery of anomalies that we will be able to push beyond the boundaries of life as we know it on Earth.

Roadmap Objectives

- **Objective No. 7.1: Biosignatures to be sought in Solar System materials**

Mission Involvement

<i>Mission Class*</i>	<i>Mission Name (for class 1 or 2) OR Concept (for class 3)</i>	<i>Type of Involvement**</i>
3	life definition	Co-Investigator

* Mission Class: Select 1 of 3 Mission Class types below to classify your project:

1. Now flying OR Funded & in development (e.g., Mars Odyssey, MER 2003, Kepler)
2. Named mission under study / in development, but not yet funded (e.g., TPF, Mars Lander 2009)
3. Long-lead future mission / societal issues (e.g., far-future Mars or Europa, biomarkers, life definition)

** Type of Involvement = Role / Relationship with Mission

Specify one (or more) of the following: PI, Co-I, Science Team member, planning support, data analysis, background research, instrument/payload development, research or analysis techniques, other (specify).